(12) UK Patent Application (19) GB (11) 2 376 857 (13) A

(43) Date of A Publication 24.12.2002

(21) Application No 0115309.7

(22) Date of Filing 22.06.2001

(71) Applicant(s)
Motorola Inc
(Incorporated in USA - Delaware)
Corporate Offices,
1303 East Algonquin Road, Schaumburg,
Illinois 60196, United States of America

(72) Inventor(s)
John Hughes
Stephen Mark Brunt
Timor Kadir

(74) Agent and/or Address for Service
Colin Treleven
European Intellectual Property
Department, Midpoint, Alencon Link,
BASINGSTOKE, Hants, RG21 7PL,
United Kingdom

(51) INT CL[7]
H04L 29/06 1/16

(52) UK CL (Edition T)
H4P PENX PPEC

(56) Documents Cited
EP 1085725 A1 WO 2000/013455 A1
CN 001263392 A JP 110088462 A
JP 070336366 A US 5396613 A

(58) Field of Search
UK CL (Edition T) H4P PEND PENL PENX PPEC
INT CL[7] H04L 1/08 1/16 1/18 29/06, H04Q 7/22
Other: Online: WPI, EPODOC, JAPIO

(54) Abstract Title

Proxy server for delivering information in a multimedia communication system

(57) A proxy server 136 for a multimedia communication system acts as an intermediary between a source communication unit 402 and a destination communication unit 406. A multiplexed stream 410 transmitted from the source to the destination is received by the proxy sever, demultiplexed and the non-real-time data extracted. The extracted non-real-time data is error checked and, if required, a retransmission request 420 is sent to the source unit, otherwise a copy of the non-real-time data is stored for possible retransmission to the destination. To minimise the delay in the end-to-end link the multiplexed stream is also forwarded immediately by the proxy server to the destination node 412. If the destination receives non-real-time data in error, a repeat request 430 is made to the proxy server rather than the source unit. Applications include cellular communication systems such as UMTS and GPRS.

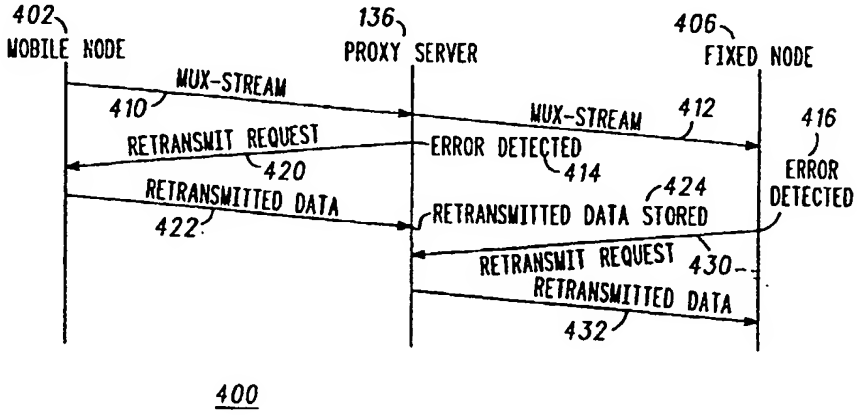

FIG. 4

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

GB 2 376 857 A

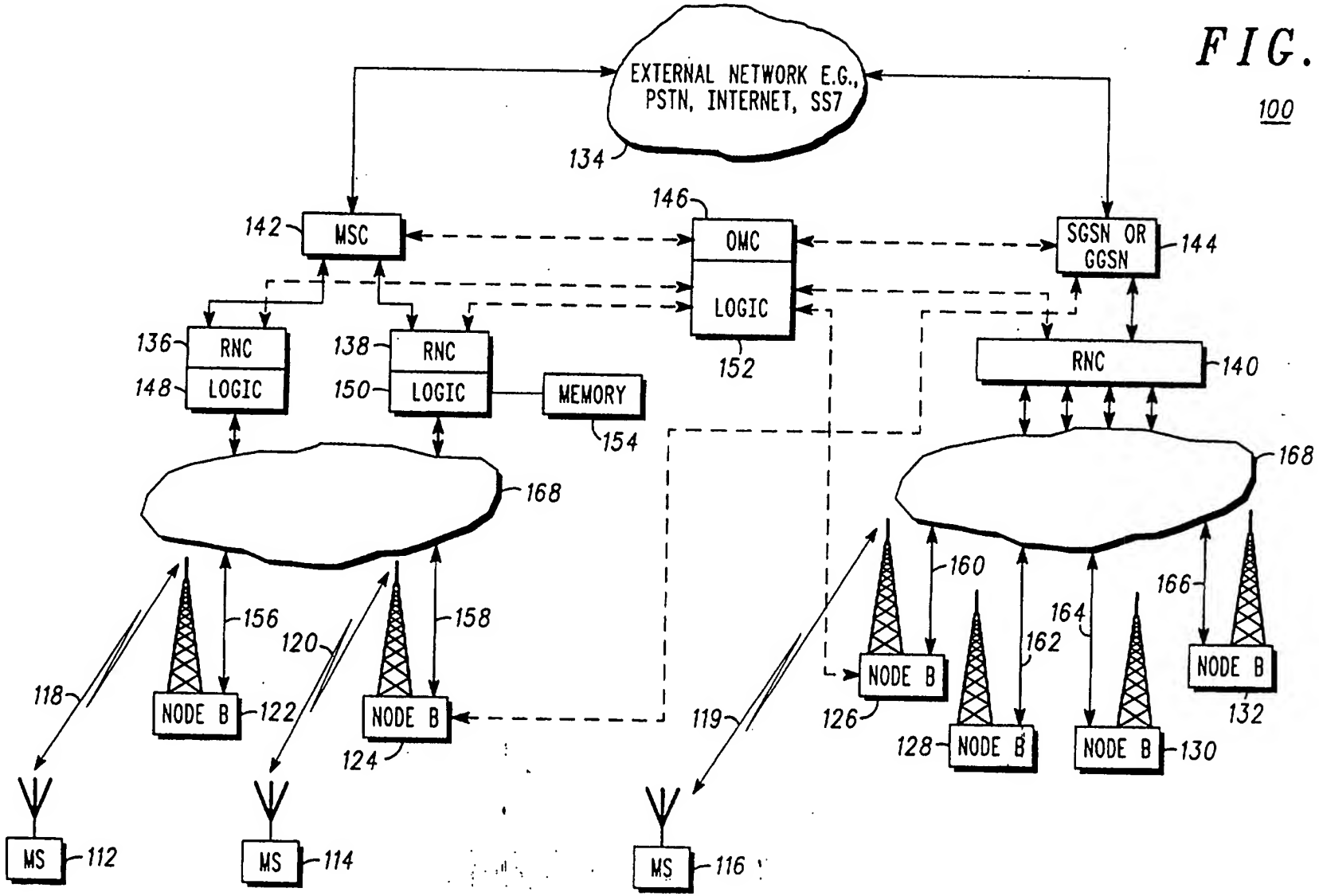
EXTERNAL NETWORK E.G., PSTN, INTERNET, SS7
134
100
146
142
MSC
OMC
LOGIC
152
SGSN OR GGSN
144
136
RNC
148
LOGIC
138
RNC
150
LOGIC
MEMORY
154
RNC
140
168
168
160
166
164
162
156
120
158
118
NODE B
122
NODE B
124
119
NODE B
126
NODE B
128
NODE B
130
NODE B
132
MS
112
MS
114
MS
116

FIG. 1

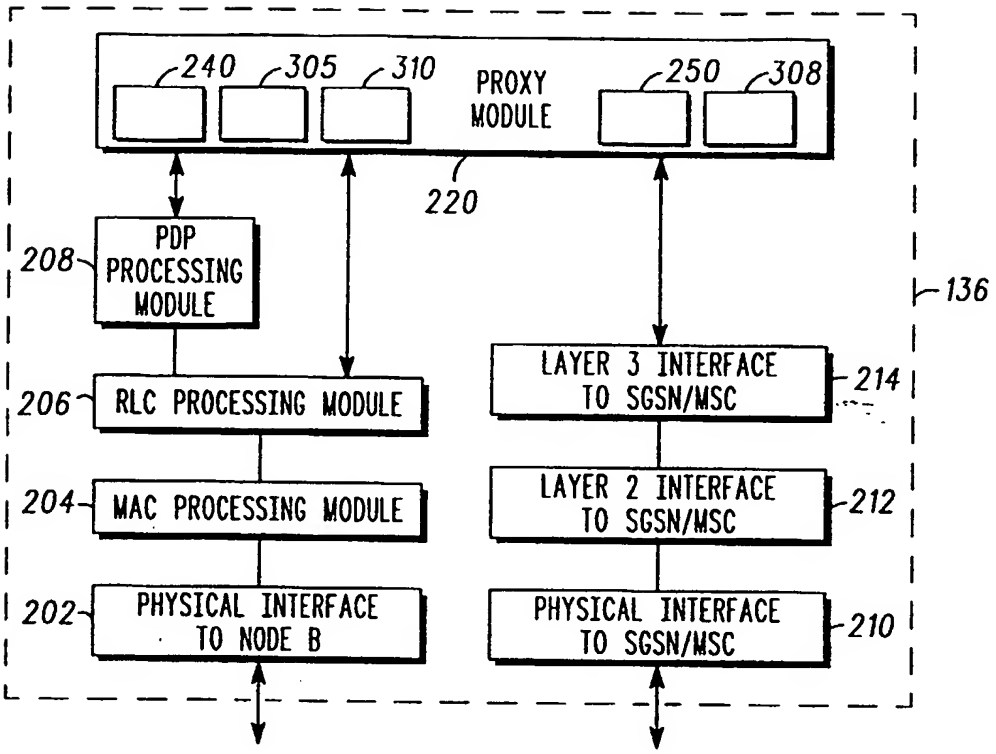
240
305
310
PROXY MODULE
250
308
220
PDP PROCESSING MODULE
208
136
LAYER 3 INTERFACE TO SGSN/MSC
214
206
RLC PROCESSING MODULE
LAYER 2 INTERFACE TO SGSN/MSC
212
204
MAC PROCESSING MODULE
202
PHYSICAL INTERFACE TO NODE B
PHYSICAL INTERFACE TO SGSN/MSC
210

FIG. 2

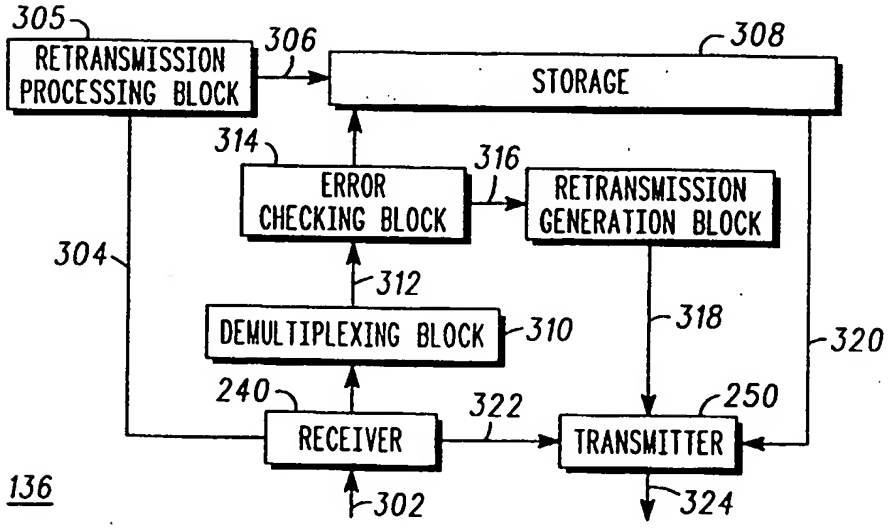
305
RETRANSMISSION PROCESSING BLOCK
306
308
STORAGE
314
316
ERROR CHECKING BLOCK
RETRANSMISSION GENERATION BLOCK
304
312
318
320
DEMULTIPLEXING BLOCK
310
240
322
250
RECEIVER
TRANSMITTER
136
302
324

FIG. 3

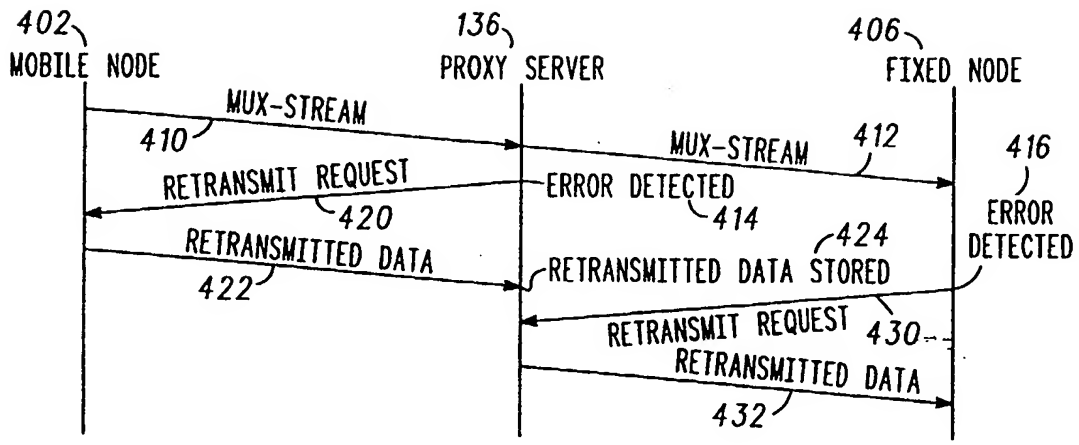
402
MOBILE NODE
136
PROXY SERVER
406
FIXED NODE
MUX-STREAM
410
MUX-STREAM
412
416
RETRANSMIT REQUEST
420
ERROR DETECTED
414
ERROR DETECTED
RETRANSMITTED DATA
422
424
RETRANSMITTED DATA STORED
RETRANSMIT REQUEST
430
RETRANSMITTED DATA
432
400

FIG. 4

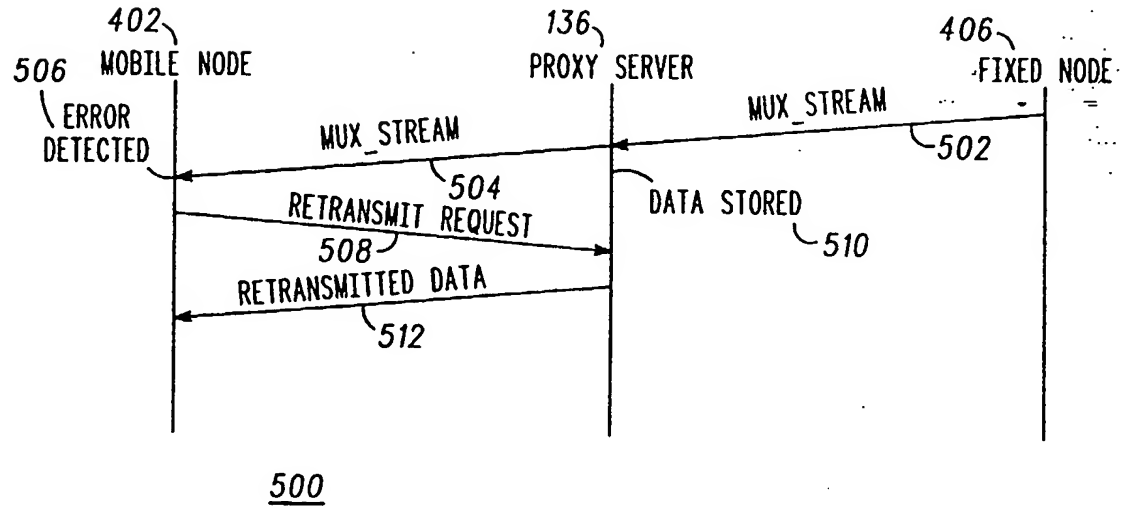
402
MOBILE NODE
136
PROXY SERVER
406
FIXED NODE
506
ERROR DETECTED
MUX_STREAM
504
MUX_STREAM
502
RETRANSMIT REQUEST
508
DATA STORED
510
RETRANSMITTED DATA
512
500

FIG. 5

Proxy Server And Method For Delivering Information In A Multimedia Communication System

Field of the Invention

This invention relates to the transmission of multiple streams of information, in particular where the streams are multiplexed together. The invention has particular applicability where some of the streams being transmitted are delay-sensitive (for example video images) and/or some of the streams are highly susceptible to errors (for example control information). The invention aims to reduce delays incurred in re-transmitting erroneous information while ensuring delay-sensitive traffic is received with minimum delay.

Background of the Invention

Present day communication systems, both wireless and wire-line, have a requirement to transfer data between communications units. Examples of data, in this context, include speech communication and multimedia communication such as video/image. Such data transfer needs to be effectively and efficiently provided for, in order to optimise use of limited communication resources.

For data to be transferred across communication networks, a communication unit addressing protocol is required. The communication units are generally allocated addresses that are read by a communication bridge, gateway and/or router, in order to determine how to transfer the data to

the addressed destination communication unit. The interconnection between networks is generally known as internetworking (or internet).

Networks are often divided into sub-networks, with protocols defining a set of rules that allow the orderly exchange of information. Currently, the most popular protocol used to transfer data in communications systems is the Internet Protocol (IP).

IP corresponds to data transfer in the network layer of the well-known OSI model. Its operation is transparent to the physical and data link layers and can thus be used on any of the standard cabling networks such as Ethernet, FDDI or token ring.

The Internet Protocol adds a data header on to the information passed from the transport layer. The resultant data packet is known as an Internet datagram. The header of the datagram contains information such as destination and source IP addresses, the version number of the IP protocol etc. An IP address is assigned to each node on the Internet. It is used to identify the location of the network and any sub-networks.

The IP program running on each node knows the location of a gateway on the network, where the gateway links the interconnected networks. Data then passes from node to gateway through the Internet. If the data to be transmitted is particularly large, the Internet Protocol also facilitates fragmentation of the data into smaller

units. When a datagram is being routed, or is being reassembled, errors can occur. When such errors occur, the node that detects the error may report back to the source node.

When transmitted from the source node, each datagram is routed separately through the Internet and the received fragments are finally reassembled at the destination node, prior to forwarding the data to the respective communication unit.

Nodes on an IP network are either hosts or routers. Any nodes that run application software, or are terminals, are defined as hosts. Any node which is able to route IP packets through and between networks is called an IP router node. This node must have the necessary network controller boards to physically interface to other networks.

With an ever-increasing need to transmit more and more information with greater speed and more efficiency, it is known that the use of communication resources in data transmission systems, particularly mobile radio and cellular telephony systems, needs to be optimised. In particular, due to the recent growth in wireless internet communications, there exists a need to provide efficient data transfer techniques in such wireless communication domains.

An established harmonised cellular radio communication system is GSM (Global System for Mobile Communications).

An enhancement to this cellular technology can be found in the General Packet Radio System (GPRS), which provides packet switched technology on a basic cellular platform, such as GSM. A yet further enhancement to improve system capacity can be found in the recently standardised Enhanced Data Rate for Global Evolution (EDGE) that encompasses Enhanced GPRS (EGPRS). A still further harmonised wireless communication system currently being defined is the universal mobile telecommunication system (UMTS). UMTS is intended to provide a harmonised standard under which cellular radio communication networks and systems will provide enhanced levels of interfacing and compatibility with many other types of communication systems and networks, including fixed communication systems such as the Internet.

Information to be transmitted across the Internet is packetised, with packet switching routes established between a source node and a destination node. Hence, GPRS and UMTS networks have been designed to accommodate packet switched data to facilitate Internet services, such as message services, information services, conversational services and casting services.

Most services are initiated and activated from UMTS terminals. However, some services may be initiated from an Internet node, for example an audio or video conferencing service, home automation notification, job dispatching and information broadcast. These latter types of services are generally referred to as Internet-initiated services.

In wireless communication systems, such as mobile radio and cellular telephony systems, radio links are established between a base station (the exact form of which depends on the type of mobile radio system) and a mobile station (also known as a mobile terminal, subscriber unit, subscriber module etc.). Each of such a base station and mobile station represent a communication unit. The parts of a respective communication unit concerned with controlling the radio link established between the two communication units are referred to as the radio link control block. The mobile station can be, for example, a mobile telephone.

Methods of simultaneously sharing communication resources in a communication network exist where the resources are shared by a number of users. Such methods are termed multiple access techniques. A number of multiple access techniques exist, whereby a finite communication resource is divided into any number of physical parameters, such as:

(i) frequency division multiple access (FDMA) whereby the total number of frequencies used in the communication system are shared,

(ii) time division multiple access (TDMA) whereby each communication resource, say a frequency used in the communication system, is shared amongst users by dividing the resource into a number of distinct time periods (time-slots, frames, etc.), and

(iii) code division multiple access (CDMA) whereby communication is performed by using all of the respective

frequencies, in all of the time periods, and the resource is shared by allocating each communication a particular code, to differentiate desired signals from undesired signals.

The communication link from the BTS to a MS is referred to as the down-link. Conversely, the communication link from a MS to the BTS is referred to as the up-link.

In the field of this invention it is known that some multimedia communication systems transmit multiple data streams, multiplexed together. Therefore a single data 'packet' carried over the transmission system may contain video, audio, control, user data etc. Examples of such multimedia systems are H.324 (which uses the H.223 multiplex) and MPEG4, that may use a Real Time Protocol (RTP) multiplex scheme.

H.324 is a set of protocols used for multimedia communication over circuit switched communication channels. H.324 defines support for video, speech, control and data traffic. Prior to transmitting such traffic, all traffic streams are multiplexed together using the multiplex protocol H.223.

MPEG4 defines a complete framework for multimedia communication including video, audio and data traffic streams. Video and audio streams can be sub-divided into sub-streams of differing requirements in terms of throughput required, error resilience, delay etc. To carry MPEG4 over IP, all streams may be carried in

individual real-time packets (RTP) or streams may be multiplexed together prior to being placed in RTP packets.

The information carried in multiplexed streams is typically a mixture of delay-sensitive information (audio, video) and information (for example control and user data) that must be received error-free by the destination communication unit.

It is also known that re-transmission protocols exist to ensure a data packet transmitted from a source communication unit may be ultimately delivered to a destination communication unit. Such re-transmission protocols resolve problems when a data packet is subjected to interference during transmission, resulting in errors when first received at the destination communication unit. On reception of a multiplexed packet that includes control or user data containing errors, the destination communication unit may request that the information be re-transmitted by the source communication unit. Known re-transmission protocols do not treat delay-sensitive traffic as a special case and, as such, process such delay-sensitive traffic in this same manner.

The delay between transmitting a request for the information to be re-sent by the source and receiving the information that has been re-sent can be fairly high, especially over low bandwidth communication links. Hence, schemes to reduce this 'round-trip delay' are very desirable.

A known scheme for reducing this delay is to store information, which may need to be re-transmitted, in a proxy server between the boundary of error-prone links and error-free links. Typical error-prone links are wireless communication channels.

With this scheme, where information is being transmitted from a mobile node to a fixed node via a proxy server, the proxy server will check the packet for errors after it has been transmitted over the wireless link. If errors are detected then a request is sent immediately from the proxy server to the mobile node for a re-transmission. This obviously reduces the delay compared to the typical "round-trip" re-transmission where the proxy server would have to forward the packet(s) in error to the fixed node and wait for a request for re-transmission from the fixed node.

The proxy server may also store a copy of the packet, in addition to forwarding the information to the fixed node. In this way, any re-transmission request from the fixed node, resulting from errors occurring over the links between the proxy server and the fixed node, can be handled directly by the proxy server. Hence, no re-transmitted information will need to be sent over the error-prone wireless link.

Also with this scheme, in the case of a fixed node sending information to a mobile node, the proxy server will check the information for any errors. If errors are

detected (having occurred over the links between the fixed node and the proxy server), a request will be sent from the proxy server to the fixed node for the information to be re-transmitted. Again this reduces the delay in sending a re-transmission request, as compared to waiting for a request for re-transmission from the mobile node.

More importantly, as well as forwarding the information over the wireless network to the mobile node, the proxy server may store a copy of the information. Hence if the information arrives at the mobile node with errors (having occurred over the wireless link between the proxy server and the mobile node) resulting in a re-transmission request being sent by the mobile node, this re-transmission request will be handled directly by the proxy server. Hence, no re-transmission request will need to be sent from the proxy server to the fixed node over the wireless link, thereby reducing the round trip delay.

Known methods that are used for transmitting multiplexed media streams are subjected to errors in a wireless environment. Often such errors are dealt with by the use of extensive amounts of Forward Error Correction (FEC) to help reduce the impact of errors. However, very often it is not possible to control, or a designer may not wish to control, the level of FEC. One example would be where the system designer wants the application to work with both wireline and wireless users. In this case, the designer would not want to add needless error protection

to the multiplexed media streams destined for wireline users, as this will only take away much-needed bandwidth.

In the case where some FEC is applied to the individual multiplexed media streams, there is still a very good chance that the information will be subjected to errors. In the case of error sensitive non-real time information, for example a control message saying switch to a different transmission rate, a re-transmission will be required. This re-transmission will be delayed by at least the round trip time and perhaps more if either the re-transmission request or the re-transmitted data are subjected to errors. Hence, although the real-time information will be delivered, the non-real-time traffic suffers from the unreliability of the wireless channel and due to re-transmissions is delayed more than would be desired.

A proxy server could be considered for use in a wireless environment having the responsibility of detecting at the wireline/wireless interface any errors in the non-real-time information. In considering the use of a proxy server the multiplexed media stream will first have to be de-multiplexed. The non-real-time information multiplexed media streams will be analysed for errors and the streams will then be multiplexed again before being forwarded to the eventual destination. This will introduce an unacceptable delay in the real time streams.

Hence, such proxy server mechanisms are generally deemed impractical for delay-sensitive multiplexed multimedia streams.

Thus there exists a need in the field of the present invention to provide a network proxy server for multimedia communication system and a means of relaying multiplexed information, such as delay-sensitive multimedia information, wherein the abovementioned disadvantages may be alleviated.

Summary of the Invention

In accordance with the present invention there is provided a proxy server for a multimedia communication system, as claimed in claim 1.

In accordance with the present invention there is provided a method for delivering a multiplexed information stream from a source communication unit to a destination communication unit, as claimed in claim 7.

In accordance with the present invention there is provided a multi-media communication system, as claimed in claim 13.

In accordance with the present invention there is provided a multi-media communication system, as claimed in claim 14.

In accordance with the present invention there is provided a storage medium, as claimed in claim 15.

Brief Description of the Drawings

Exemplary embodiments of the present invention will now be described, with reference to the accompanying drawings, in which:

FIG. 1 shows a cell-based communication system in accordance with a preferred embodiment of the present invention.

FIG. 2 shows a block diagram of an intermediate serving communication unit, namely a RNC acting as a proxy server, adapted to operate in the cell-based communication system of FIG. 1.

FIG. 3 shows a functional block diagram highlighting the flow of information within a proxy server, in accordance with a preferred embodiment of the present invention.

FIG. 4 shows a message sequence chart of a communication from a mobile communication unit to a fixed communication unit, in accordance with a preferred embodiment of the present invention.

FIG. 5 shows a message sequence chart of a communication from a fixed communication unit to a mobile communication unit, in accordance with a preferred embodiment of the present invention.

Description of Preferred Embodiments

The inventors of the present invention have recognised that where a re-transmission request is handled solely by the source, and/or destination communication unit in a multiplexed multi-media communication system, then a significant round trip delay may be incurred. One aspect of the present invention is therefore to provide a mechanism that reduces the delay associated with delivering substantially error-free data, particularly for delay-sensitive data.

In particular, a proxy server and mechanism for routing data is provided where the proxy server has a capability to extract data packets 'on the fly' i.e. they continue on their way without incurring any delay. Furthermore, the proxy server processes the extracted copy of the packet to identify if there are errors in, for example, a non-real time portion of the multiplexed multi-media stream.

In a first embodiment, the invention is applied to a cellular communication system compliant with, and containing network elements of, both UMTS and/or GPRS communication systems. However, it is to be appreciated that the invention may be applied to any communication system involving a link employing at least one intermediary communication unit to relay information.

FIG. 1 shows a (predominantly) wireless cellular communication system 100 compliant with, and containing

network elements capable of operating over a UMTS and/or a GPRS air-interface.

A plurality of mobile stations (MSs) 112, 114, 116 communicate over radio links 118, 119, 120 with a plurality of base transceiver stations, referred to under UMTS terminology as Node-Bs, 122, 124, 126, 128, 130, 132. The system comprises many other MSs and base stations, which for clarity purposes are not shown.

The wireless communication system, sometimes referred to as a Network Operator's Network Domain, is connected to an external network 134, for example the Internet. The Network Operator's Network Domain includes:

(i) a core network, namely at least one Gateway GPRS Serving Node (GGSN) 144 and or at least one Serving GPRS Support Nodes (SGSN); and

(ii) an access network, namely:

(ai) a GPRS (or UMTS) Radio network controller (RNC) 136-140; or

(aii) Base Site Controller (BSC) in a GSM system

and/or

(bi) a GPRS (or UMTS) Node B 122-132; or

(bii) a Base Transceiver Station (BTS) in a GSM system.

The GGSN/SSGN 144 is responsible for GPRS (or UMTS) interfacing with a Public Switched Data Network (PSDN) such as the Internet 134 or a Public Switched Telephone Network (PSTN) 134. A GGSN 144 performs a routing and

tunnelling function for traffic within say, a GPRS core network, whilst a SGSN 144 links to external packet networks, in this case ones accessing the GPRS mode of the system.

The Node-Bs 122-132 are connected to external networks, through base station controllers, referred to under UMTS terminology as Radio Network Controller stations (RNC), including the RNCs 136, 138, 140 and mobile switching centres (MSCs), such as MSC 142 (the others are, for clarity purposes, not shown) and SGSN 144 (the others are, for clarity purposes, not shown).

Each Node-B 122-132 contains one or more transceiver units and communicates with the rest of the cell-based system infrastructure via an I_{ub} interface as defined in the UMTS specification.

Each RNC 136-140 may control one or more Node-Bs 122-132. Each MSC 142 provides a gateway to the external network 134. The Operations and Management Centre (OMC) 146 is operably connected to RNCs 136-40 and Node-Bs 122-132 (shown only with respect to Node-B 126 for clarity), and administers and manages the parts of the cellular telephone communication system 100, as will be understood by those skilled in the art.

In this embodiment, any of the intervening communication elements between source and destination nodes in an end-to-end communication path, namely a Node-B 122-132 and/or, a RNC 136-140 and/or MSC 142 and/or SGSN/GGSN 144

have been adapted, to offer, and provide for, de-multiplexing of a data stream to extract and process delay-sensitive information in a different manner to non-delay-sensitive information.

Furthermore, one or more of such element(s) has/have been adapted to perform error checking on the processed information. In addition one or more of such element(s) has/have been adapted to independently determine whether to request a re-transmission from the source node without waiting to forward such a request when received from the destination node, as will be described in more detail below.

More particularly, in this embodiment the above one or more element(s) has/have been adapted to implement the present invention in both transmitting and receiving modes of operation, such that in this embodiment the invention may be applied to both down-link (destination node being a MS) and up-link (source node being a MS) transmissions.

More generally, the adaptation may be implemented in the respective communication units in any suitable manner. For example, new apparatus may be added to a conventional communication unit, or alternatively existing parts of a conventional communication unit may be adapted, for example by reprogramming one or more processors therein. As such the required adaptation may be implemented in the form of processor-implementable instructions stored on a storage medium, such as a floppy disk, hard disk, PROM,

RAM or any combination of these or other storage multimedia.

It is also within the contemplation of the invention that such adaptation of transmission characteristics may alternatively be controlled, implemented in full or implemented in part by adapting any other suitable part of the communication system 100. For example, the OMC 146 (or equivalent parts in other types of systems) may be adapted to provide some or all of the implementation provided in this embodiment.

Further, in the case of other network infrastructures, implementation of the de-multiplexing and processing operations may be performed at any appropriate node such as any other appropriate type of base station, base station controller, etc.

Alternatively the aforementioned steps may be carried out by various components distributed at different locations or entities within any suitable network or system. Hereinafter, the term used to define such intermediary elements, or combination of elements is a "proxy server", namely an intermediate facilitator of the communication link between two end communication units.

FIG. 2 shows a block diagram of a suitable proxy server, namely RNC 136 (for simplicity only RNC 136 will be described in detail). The RNC 136 contains a physical interface 202 to the Node B 122 over which user data is transmitted and received.

The physical interface 202 is responsible for extracting information from the physical medium and presenting it in a suitable format to the MAC Processing Module 204. It is also responsible for taking information from the MAC Processing Module 204 and placing it in a format suitable to be transported over the physical medium.

The MAC Processing Module 204 controls the method by which information is passed to the Physical Interface 202. It also ensures information is in a suitable format for delivery to the RLC Processing Module 206. Functions of the MAC Processing Module 204 may include carrying out error detection and error correction procedures using schemes such as Forward Error Correction.

The radio link control (RLC) Processing Module 206 implements the RLC protocol functions, such as:

(i) segmentation of user data for transmission over the wireless air interface,

(ii) detection of missing segments,

(iii) requesting the re-transmission of missing segments,

(iv) re-transmitting requested segments, and

(v) regeneration of complete packets from received segments.

The PDP Processing Module 208 implements the Packet Data Convergence Protocol whose functions include the compression of user data and protocol headers.

Both the PDP Processing Module 208 and the RLC Processing Module may send/receive information to/from the Proxy Module 220.

The RNC 136 also contains a physical interface 210 to the SGSN 144 and/or the MSC 142. A Layer-2 Interface module 212 and Layer-3 Interface module 214 ensure information to be passed to the SGSN 144 and MSC 142 is in the correct format. They also ensure information received from the SGSN 144 and MSC 142 is in the correct format.

The Layer-3 Interface module 214 may send/receive information to/from the Proxy Module 220.

Clearly a skilled artisan would recognise that if, for example, a SGSN or MSC were to function as the proxy server in accordance with the preferred embodiment of the invention, some of the aforementioned elements may be implemented in a different manner or configuration to that in a RNC.

It is noted that corresponding features to those described above with respect to RNC 136 (and hence other proxy server arrangements) are also found in existing communication units. However, RNC 136 (and therefore any other proxy server) differs over a conventional RNC 136 by virtue that rather than information being relayed directly between the PDP Processing Module 208 and the Layer-3 Interface module 214, the RNC 136 is adapted such that all traffic is routed via a Proxy Module that receives 240, de-multiplexes 310, processes 305 and

selectively stores in memory element 308 multiplexed information including delay-sensitive data in the manner which is described in more detail below.

The step of selectively storing multiplexed information in memory element 308 of this embodiment may be introduced to the RNC 136 (or any other proxy server) in the form of processor-implementable instructions and/or data.

It is within the contemplation of the invention that the adapted features 240, 305, 310, 308 in the proxy module 220 described in the above embodiments can be embodied in any suitable form of software, firmware or hardware. The adapted features 240, 305, 310, 308 may be controlled by processor-implementable instructions and/or data, for carrying out the methods and processes described, which are stored in a storage medium or memory, for example the memory element 308. The memory element 308 can be a circuit component or module, e.g. a RAM or PROM, or a removable storage medium such as a disk, or other suitable medium.

Referring now to FIG. 3, a functional block diagram highlighting the flow of information within a RNC (proxy server) 136 is shown, in accordance with a preferred embodiment of the present invention. In particular, FIG. 3 illustrates the preferred path for handling multiplexed multimedia data/information streams within the proxy server 136.

In the case of fixed-to-mobile node communication, a multiplexed multimedia information stream 302 arriving at the receiving chain 240 of the RNC proxy server 136 is routed to two different locations. The receiving chain 240 preferably resides in the proxy module 220 (of FIG. 2) and receives data from the RLC processing module 206, PDP Processing module 208 and Layer-3 Interface 214.

The first route takes the multiplexed multimedia information stream 302 through the proxy server and forwards the information stream 302 to the transmitting chain 250 without any alterations to its content. The transmitting chain 250 also preferably resides in the proxy module 220 (of FIG. 2) and transmits data to the RLC processing module 206, PDP Processing module 208 and Layer-3 Interface 214. Multiplexed multimedia streams can then be de-multiplexed at the mobile node without incurring any delay penalty.

As well as forwarding the multiplexed multimedia information stream 302 to the mobile node, the multiplexed multimedia information stream 302 arriving at the proxy server's receiving chain 240, is also passed to the de-multiplexing block 310.

The non-real-time information stream(s) are then extracted from the multiplexed multi-media information stream 312. The non-real-time information stream(s), such as control information, user data or still image, are then checked in error checking block 314 to determine whether any errors have occurred in the non-real time

data. If the non-real time data is error-free, it is forwarded to the local storage buffer 308.

Where errors are detected 316 in the non-real-time multimedia streams, a request for re-transmission of the erroneous information is generated 318 for sending to the fixed node on behalf of the mobile node. On receiving the re-transmitted information from the fixed node (assuming it contains no errors this time), the proxy server 136 may choose to forward it directly to the mobile node or alternatively wait for the mobile node to issue its own request for re-transmission.

In the alternative, any request for re-transmission 304 that is subsequently received at receiving chain 240 from the mobile node, is intercepted and the storage buffers 308 accessed, as shown in step 306. The error-free data being requested is then extracted and routed 320 to the transmitting chain 250 to be sent to the mobile node. This ensures that where errors occur over the wireless link, then re-transmissions only take place between the proxy server and the mobile node without involving the fixed node, therefore helping to minimise re-transmission round-trip delay.

Similarly, in the case of mobile to fixed node communication, the multiplexed multimedia information stream 302 arriving at the receiving chain 240 of the proxy server 136 is again routed to two different locations. The first route takes the multiplexed multimedia information stream 302 through the proxy

server 136 and forwards the information stream 302 to the receiving fixed node without any alterations to its contents. Delay-sensitive multimedia streams may then be de-multiplexed at the fixed node without incurring any delay penalty.

On receiving the multiplexed multimedia information stream(s) 302, the proxy server 136 will de-multiplex 310 the streams, process the multiplexed multimedia streams and check for errors 314 in the non-real time data within such streams. Where the non-real-time data contains no errors, the information will be placed in the storage buffer. Where errors are detected in the non-real time data, then a request for re-transmission 318 of the erroneous information will be sent to the mobile node.

Where the proxy server detects an error, it will send a request for re-transmission 318 to the mobile node on behalf of the fixed node. On receiving the re-transmitted information from the mobile node (assuming it contains no errors this time), the proxy server 136 may choose to forward it directly to the fixed node, or alternatively wait for the fixed node to send its own request for re-transmission.

Where errors occur over the link between the proxy server and the fixed node, the fixed node will request a re-transmission. This re-transmission request will be intercepted by the proxy server, which will extract an error-free copy from its storage buffer and send it back to the mobile node. This ensures that where errors occur

over the wired link, then no re-transmission needs to be made over the more error-prone wireless link, therefore helping to minimise re-transmission round-trip delay.

It is within the contemplation of the invention that the proxy server 136 may contain two storage buffers, a receiving buffer between the proxy server and the transmitting mobile, and a transmitting buffer between the proxy server and the receiving mobile. The multiplexed multimedia information stream(s) 302 arriving at the proxy server 122 is de-multiplexed and the individual multiplexed multimedia information stream(s) 302 are stored in the receiving buffer. Simultaneously the multiplexed multimedia information stream(s) 322 is stored in the transmitting buffer, for immediate transmission to the receiving node. The proxy server 136 will then request any re-transmission of incorrect or lost packets from the transmitting mobile or fixed node in accordance with the communication protocol being used.

It is within the contemplation of the invention that such re-transmission may include whole or sub-portions or packets of the originally transmitted multiplexed multimedia information stream 302.

Referring now to FIG. 4, a message sequence chart 400 highlighting a communication from a mobile communication unit (node) 402 to a fixed communication unit (node) 406 via a proxy server (RNC) 136 is shown, in accordance with a preferred embodiment of the present invention.

In FIG. 4, the multiplexed multimedia information stream(s) 410, 412 is/are received at the mobile node 402 and routed through the proxy server 136 to the fixed node 406. However, as this information is also de-multiplexed within the proxy, an error in one of the non-real time streams is shown as being detected 416. A request is therefore sent by the proxy server 136 to the mobile node 402 for a re-transmission of the corrupted information 422.

The mobile node 402 re-transmits 422 the multiplexed multimedia information stream(s) to the proxy server 136. On receiving the re-transmitted multiplexed multimedia information stream(s), the information is stored 424 in the proxy server 136 - assuming that it is error-free or sufficiently error-free to be acceptable to the user in the context of the transmission. At the fixed node, the error in the original transmission is detected 416 and a request for re-transmission 430 is sent (theoretically) to the mobile node 402. This request for re-transmission 430 is intercepted by the proxy server 136, which extracts an error-free copy of the information from its storage buffer 424 and transmits the error-free copy 432 to the fixed node 406.

Referring now to FIG. 5, a message sequence chart 500 highlighting a communication from a fixed communication unit (node) 406 to a mobile communication unit (node) 402 via a proxy server (Node B) 136 is shown, in accordance with a preferred embodiment of the present invention. In FIG. 5, multiplexed multimedia information stream(s) 502,

504 are being transmitted from the fixed node 406 to the mobile node 402.

The multiplexed multimedia information stream(s) 502, 504 is/are routed through the proxy server 136. However, they are concurrently stored 510 in memory. At the mobile node 402, an error (occurring on the wireless link) is detected 506 and a request for re-transmission 508 is sent (theoretically) to the fixed node 406. This request for re-transmission 508 is intercepted by the proxy server 136, which extracts an error-free copy of the information from its storage 510 and returns it to the mobile node 402.

As such, the end-to-end time for ensuring error-free multiplexed multimedia information streams 502 reaching the destination node is substantially reduced in error-prone situations/environments.

The present invention finds particular application in wireless communication systems such as the UMTS or GPRS systems. However, the inventive concepts contained herein are equally applicable to alternative fixed and/or wireless communication systems. Whilst the specific, and preferred, implementations of the present invention are described above, it is clear that variations and modifications of such inventive concepts could be readily applied by one skilled in the art.

In the above embodiment, the proxy server is described with reference to a RNC 136 of a UMTS or GPRS

communication system. In other embodiments, the proxy server may include or consist of any other form of intermediate communication unit, located between source and destination communicating units, for example a Node B, BTS, MSC, etc. In further embodiments, it is contemplated that the proxy function may be located on a boundary between a wireless link and a wire-line link, for example co-located with a GSM BTS or TETRA BTS or a satellite ground station.

It is also contemplated that the proxy server function may be located within a packet data router such as the SGSN or GGSN in a GPRS or UMTS communication system. It is also contemplated that the proxy server function may be located in a device that acts as a gateway between two networks, for example where a multimedia Gateway is used, such as Tiphon networks or other multimedia-over-IP type networks.

Furthermore, although the invention is described with reference to a cell-based communication system, it is within the contemplation of the invention that the inventive concepts can be applied to any wire-line or wireless data transmission system in applications such as down-loading or up-loading information to personal computers, electronic organizers, video and/or audio players, etc.

It will be understood that the proxy server described above, particularly used in a multiplexed multimedia communication system such as UMTS that uses protocols

such as H.263, MPEG4 or H.324, enables both delay-sensitive and non-delay-sensitive streams to be transported in a multiplex stream with minimum delay in an end-to-end communication link.

In summary, a proxy server for a multimedia communication system, located between a source communication unit and a destination communication unit, has been provided. The proxy server includes a receiver receiving a multiplexed information stream transmitted from said source communication unit to said destination communication unit; a processor for de-multiplexing the received multiplexed information stream and extracting non-real-time data from said multiplexed information stream. The proxy server includes error detection means, operably coupled to a transmitter and a memory element for determining whether an error exists in the extracted non-real-time data. If an error is detected: a non-real-time data re-transmission request is transmitted to the source communication unit. If an error is not detected: a copy of the extracted non-real-time data is stored in said memory element.

Furthermore, a method for delivering a multiplexed information stream from a source communication unit to a destination communication unit via a proxy server has been provided. The method includes the following steps at the proxy server: receiving a multiplexed information stream transmitted from the source communication unit. The received multiplexed information stream is de-multiplexed. The non-real-time data is extracted from

the de-multiplexed information stream. A determination is made as to whether an error exists in the extracted non-real-time data. If an error is detected, a non-real-time data re-transmission request is transmitted to the source communication unit. If an error is not detected, a copy of said extracted non-real-time data is stored.

A multi-media communication system that includes the aforementioned proxy server has been provided.

A multi-media communication system including at least one communication unit adapted to perform any of the aforementioned method steps has also been provided.

Finally, a storage medium storing processor-implementable instructions for controlling a processor to carry out any of the aforementioned method steps has been provided.

Thus, a network proxy server for multimedia communication system and a means of relaying information, such as delay-sensitive multimedia information, has been provided where the abovementioned disadvantages associated with prior art arrangements have been alleviated.

Claims

1. A proxy server (136) for a multimedia communication system (100) located between a source communication unit (402, 406) and a destination communication unit (406, 402), comprising:

a receiver (240) receiving a multiplexed information stream transmitted from said source communication unit to said destination communication unit;

a processor (310) for de-multiplexing the received multiplexed information stream and extracting non-real-time data from said multiplexed information stream;

wherein said proxy server (136) is characterised by:

error detection means (314), operably coupled to a transmitter (250) and a memory element (308), for determining whether an error exists in the extracted non-real-time data; wherein:

if an error is detected, a non-real-time data re-transmission request is transmitted to the source communication unit(402, 406); or

if an error is not detected, a copy of the extracted non-real-time data is stored in said memory element (308).

2. The proxy server (136) according to claim 1, the proxy server (136) further characterised by a transmitter (250)

for transmitting said multiplexed information stream to said destination communication unit whilst substantially concurrently determining whether an error exists in the extracted non-real-time data.

3. The proxy server (136) according to claim 1 or claim 2, the proxy server (136) further characterised by the receiver (240) intercepting a re-transmission request (430) from the destination communication unit (406) relating to the non-real-time multiplexed information stream and said processor retrieves said stored error-free multiplexed information stream or non-real-time data from the memory element (308) and re-transmits (432) said error-free multiplexed information stream to said destination communication unit (406).

4. The proxy server (136) according to claim 1 or claim 2, the proxy server (136) further characterised by the receiver (240) receiving said non-real-time data re-transmission from the source communication unit (402, 406) and, if the re-transmitted multiplexed information stream is received at least substantially error-free, either re-transmitting said multiplexed information stream or said non-real-time data to said destination communication unit (406, 402) or storing said re-transmitted multiplexed information stream or said non-real-time data for subsequent transmission, for example on receiving a re-transmission request (430, 508) from said destination communication unit (406, 402).

5. The proxy server (136) according to any of the preceding claims, further characterised by the proxy server (136) being located in one of:

(i) a boundary between a wireless link and a wire-line link,
(ii) within a packet data router,
(iii) in a device that acts as a gateway between two networks.

6. The proxy server (136) for a multimedia communication system (100) according to any of the preceding claims, wherein the multimedia communication system (100) employs at least one of the following protocols: H.324, H.263, MPEG4.

7. A method (400, 500) for delivering a multiplexed information stream from a source communication unit (402, 406) to a destination communication unit (406, 402) via a proxy server (136), the method comprising the following steps at the proxy server:

receiving a multiplexed information stream (410, 502) transmitted from said source communication unit (402, 406);

de-multiplexing the received multiplexed information stream (410, 502);

extracting non-real-time data from said de-multiplexed information stream;

the method characterised by the steps of:

determining whether an error exists in the extracted non-real-time data; wherein:

if an error is detected, transmitting a non-real-time data re-transmission request (420) to the source communication unit (402); or
if an error is not detected, storing (510) a copy of said extracted non-real-time data.

8. The method (400, 500) for delivering a multiplexed information stream according to claim 7, the method further characterised by the proxy server transmitting said multiplexed information stream to said destination communication unit whilst substantially concurrently determining whether an error exists in the extracted non-real-time data.

9. The method (400, 500) for delivering a multiplexed information stream according to claim 7 or claim 8, the method further characterised by the proxy server performing the steps of:

intercepting a re-transmission request (430, 508) from said destination communication unit (406, 402) associated with said non-real time multiplexed information stream;

retrieving at least said extracted non-real-time data; and

re-transmitting (432, 512) said extracted non-real-time data to said destination communication unit (406, 402).

10. The method (400, 500) for delivering a multiplexed information stream according to claim 7 or claim 8, the method further characterised by the proxy server performing the steps of:
receiving said non-real-time data re-transmission from the source communication unit (402) and, if the re-transmitted multiplexed information stream is received at least substantially error-free, either:
re-transmitting said substantially error-free multiplexed information stream to said destination communication unit; or
storing (424) said re-transmitted substantially error-free multiplexed information stream and subsequently transmitting (432) such stream to said destination communication unit, for example on receiving a re-transmission request from said destination communication unit.

11. The proxy server (136) according to any of claims 1 to 6 or the method (400, 500) for delivering a multiplexed information stream according to any of claims 7 to 10 where said multiplexed information stream is a multimedia multiplexed information stream.

12. The proxy server according to any of claims 1 to 6, 11, or the method for delivering a multiplexed information stream according to any of claims 7 to 11 wherein said proxy server functions or steps are

performed in one or more of a: Gateway GPRS Serving Node (144), Serving GPRS Support Nodes (144), GPRS or UMTS Radio network controller (136-140), Base Site Controller, a GPRS or UMTS Node B (122-132), Base Transceiver Station, mobile switching centres (142), Operations and Management Centre (146).

13. A multi-media communication system comprising a proxy server according to any of claims 1 to 6.

14. A multi-media communication system (100) comprising at least one communication unit adapted to perform the method steps of any of claims 7 to 12.

15. A storage medium (216) storing processor-implementable instructions for controlling a processor to carry out the method of any of claims 6 to 11.

16. A proxy server for a multimedia communication system substantially as hereinbefore described with reference to, and/or as illustrated by, FIG. 2 or FIG. 3 of the accompanying drawings.

17. A multimedia communication system substantially as hereinbefore described with reference to, and/or as illustrated by, FIG. 1 of the accompanying drawings.

18. A method for delivering a multiplexed information stream substantially as hereinbefore described with reference to, and/or as illustrated by, FIG. 4 or FIG. 5 of the accompanying drawings.

Application No: GB 0115309.7 **Examiner:** Matthew Nelson
Claims searched: 1-18 **Date of search:** 25 January 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): H4P (PEND, PENL, PENX, PPEC)

Int Cl (Ed.7): H04L 1/08, 1/16, 1/18, 29/06; H04Q 7/22

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	EP 1085725 A1	(ALCATEL) See the abstract.	1,3-7,9-15
Y	WO 00/13455 A1	(INTEL CORPORATION). See e.g. the abstract, p. 11, line 24 - p. 12, line 4 and the claims.	1,3-7,9-15
A	US 5396613	(HOLLAAR) See whole document.	
Y	CN 1263392 A	(UNIV QINGHUA) See online abstract.	1,3-7,9-15
Y	JP 110088462 A	(TOSHIBA) See online abstract.	1,3-7,9-15
Y	JP 070336366 A	(CANON) See online abstract.	1,3-7,9-15

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.